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DOES THE CAPITAL INTENSITY MATTER? EVIDENCE FROM THE POSTWAR JAPANESE ECONOMY AND OTHER OECD COUNTRIES

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The capital intensity takes an important role in two-sector and multisector growth models. Surprisingly very few empirical studies have been conducted so far except by Kuga (1967). This fact implies that few people have ever tried to perform any empirical research to study whether the two-sector and multisector optimal growth models could explain the economic development properly based on the empirical data. Although we witnessed fairly active theoretical research on two-sector and multisector growth models in the 1990s and recent years, R. M. Solow has thrown doubt on the capital intensities [in Philippe Aghion and Steven Durlauf (eds.), *Handbook of Economic Growth,* Vol. 1A (2005, pp. 3–10)]. Our purpose is to measure the capital intensities of the consumption good and the investment good sectors mainly in the postwar Japanese economy, and also in other OECD countries. By so doing, we will demonstrate that the capital intensity does matter and our empirical evidence will strongly support the common assumption that the consumption goods sector is more capital-intensive than the capital goods sector.

Keywords: Two-Sector Model, I–O Table, Capital Intensity, Capital-Intensity Reversal, Solow–Swan Growth Model

1. INTRODUCTION

Since Uzawa's seminal papers (1962, 1963, 1964), a two-sector growth model has become very popular in the theory of economic growth. As emphasized by Okuno-Fujiwara and Shell (2009) in an interview with Hirofumi Uzawa,[1] the crucial difference between one-sector and two-sector models is that two-sector models allow a production possibility frontier that is strictly concave to the origin,

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in sharp contrast to being necessarily flat, and this generality allows richer and more complicated dynamics. In fact, Benhabib and Nishimura (1985) studied a reduced-form model of two-sector optimal growth and demonstrated the competitive cycles. After that, more complicated economic behaviors in two-sector models were studied by Nishimura and Yano (1995), Benhabib et al. (2002), and Nishimura and Venditti (2004),[2] among others. Furthermore, the two-sector growth model has been extended to the overlapping-generations model by Galor (1992) and to the endogenous growth models by Bond et al. (1996), Mino (1996) and Takahashi (2001). In all of these two-sector growth models, the capital intensities play an important role in the existence and stability of the optimal steady state. Although we have witnessed fairly active research on two-sector and multisector growth models in the 1990s and later, Solow (2005) has thrown doubt on the capital intensities.

> In the early stages there was active exploration of two-sector models, culminating in the book by Duncan Foley and Miguel Sidrauski, but it petered out fairly soon. The reason was probably internal-intellectual rather than any feeling that the applications were unimportant. The usual, perfectly reasonable, choice was to distinguish between a consumption-good producing sector and an investment-good producing sector. I have the feeling that too much in those models turned out to depend on differences in factor-intensity between the sectors. We have very little in the way of facts or intuition about that issue, and there was no reason to expect or postulate any systematic pattern that could lead to exciting results.[3]

His main criticism focused on the common capital-intensity assumption—that the consumption goods sector is more capital intensive than the investment goods sector—which is often postulated in two-sector models.

In this paper, we have based the discussion on the two-sector growth models originally investigated in a series of papers by Uzawa and will try to measure the capital intensities of the consumption goods and investment goods sectors, mainly in the postwar Japanese economy. By so doing, we would like to give firm empirical evidence of the capital intensities and to reply to the questions raised by Solow.

The capital intensity is the ratio of capital stock to labor input in each sector. We will observe how each sector's capital intensity changed in the postwar Japanese economy. We will especially focus on the interactions of the capital intensities of the two sectors. It is very surprising that no such research has been done yet except by Kuga (1967). This fact implies that few investigators ever tried to perform empirical research to study whether two-sector optimal growth models could explain economic development properly based on the empirical data.[4] Following Kuga (1967), based on the I–O tables, we will aggregate the Japanese economy into two sectors, the consumption goods and the investment goods sectors. In Japan, the I–O table has been published every five years from 1955 to 2000. So we have 10 I–O tables for the Japanese economy so far.

Our main empirical findings are as follows: (1) The consumption goods sector grew faster than the investment goods sector in the postwar Japanese economy.

(2) Both technical progress and demand effect played important roles in the Japanese high-speed growth era. (3) The capital intensity of the consumption goods sector was higher than that of the investment goods sector in the Japanese high-speed growth era. This reversed around 1975 in Japan. (4) Among OECD countries, the capital intensity of the consumption goods sector is higher than that of the investment goods sector, and the capital-intensity reversal cannot be observed, at least during our observation period. These findings will justify the capital-intensity assumption.

The structure of this paper is as follows: In Section 2, we will explain how the Japanese economy can be integrated into two sectors, the consumption and investment goods sectors. We describe how to measure the capital intensities of both sectors based on the I–O tables. The data needed for our estimation will also be explained. In Section 3, the main empirical results will be presented and discussed. We will also apply the same method as implemented in Section 2 to other main OECD countries, and the results concerning only the United States, Canada, France, and West Germany will be reported. In Section 4, we will derive some empirical implications based on our observations. Section 5 will be assigned to final remarks where we compare our result with that based on the Solow–Swan one-sector growth framework.

2. METHOD AND DATA

We will apply the method adopted by Kuga (1967), which was originally invented by Leontief (1954), when he reported the famous "Leontief Paradox."[5] Since then, the Japanese I–O tables have been well developed. No such research, however, has been conducted again after Kuga (1967).

Suppose that the equilibrium conditions based on the n-sector I–O table measured by producers' prices are given as follows:

$$(\mathbf{I} - \mathbf{A})\mathbf{Y} = \mathbf{C} + \mathbf{F},$$

where $\mathbf{I}$ is the unit matrix, $\mathbf{A}$ is the input–output matrix, $\mathbf{Y}$ is the output vector, $\mathbf{C}$ is the private final consumption vector, and $\mathbf{F}$ is the private investment vector.

Based on this relation, we may define the outputs of the consumption goods and the investment goods sectors as follows:

$$Y_I = (1, \ldots, 1)(\mathbf{I} - \mathbf{A})^{-1}\mathbf{F},$$

$$Y_c = (1, \ldots, 1)(\mathbf{I} - \mathbf{A})^{-1}\mathbf{C}$$

where $Y_i\,(i = I, C)$ is the aggregated output of each sector.

Furthermore, each sector's capital coefficient vector could be defined as follows:

$$\kappa = (K_1/Y_1, \ldots, K_n/Y_n),$$

$$\tau = (\ell_1/Y_1, \ldots, \ell_n/Y_n)$$

where K_i is the ith industry's capital stock and ℓ_i is the ith industry's labor input. Combining both relations yields

$$\mathbf{K}_c = \kappa(\mathbf{I} - \mathbf{A})^{-1}\mathbf{C},$$
$$\mathbf{L}_c = \tau(\mathbf{I} - \mathbf{A})^{-1}\mathbf{C}$$

for the consumption goods sector, and for the investment goods sector

$$\mathbf{K}_I = \kappa(\mathbf{I} - \mathbf{A})^{-1}\mathbf{F},$$
$$\mathbf{L}_I = \tau(\mathbf{I} - \mathbf{A})^{-1}\mathbf{F}.$$

From these definitions, each sector's capital stock and labor input are the total capital stocks and the total labor inputs directly and indirectly used to produce the private final consumption and the private investment. We think that this aggregation method is intuitively justified. Furthermore, capital–output and labor–output ratios of the two sectors will be defined as follows:

$$\frac{K_C}{Y_C}, \frac{L_C}{Y_C}, \frac{K_I}{Y_I}, \text{ and } \frac{L_I}{Y_I}.$$

Finally, the capital intensity of the two sectors will be defined as follows:

$$k_C = \frac{\kappa(\mathbf{I} - \mathbf{A})^{-1}\mathbf{C}}{\tau(\mathbf{I} - \mathbf{A})^{-1}\mathbf{C}}$$

and

$$k_I = \frac{\kappa(\mathbf{I} - \mathbf{A})^{-1}\mathbf{F}}{\tau(\mathbf{I} - \mathbf{A})^{-1}\mathbf{F}}.$$

If the capital intensity increases without increasing the labor input, we may call it "capital deepening." On the other hand, if it increases with an increasing labor input, we will call it "capital widening."

We will apply the method just explained to the 10 tables published every five years from 1955 to 2000 by the Statistics Bureau of the Ministry of Public Management, Home Affairs, Posts and Telecommunications. We use the 46-sector tables based on producers' nominal prices.[6] The sectors will then be aggregated into the following 24 sectors[7] to maintain consistency with the sector classification by the kind of economic activity (industry) of the private capital stock and the employed persons data for the national accounts.

Note that we could use the 13-sector I–O tables instead of the 46-sector ones, where all the sectors from Sector (3) to Sector (15) are integrated as the "Manufacturing" sector. However, the 13-sector tables are so coarse that the manufacturing sector's capital coefficient is seriously overestimated, and it follows that the capital stocks used in the consumption goods sector will also be seriously overestimated. To avoid this bias, we need reasonably fine I–O tables.[8] We will calculate the capital intensities of the consumption goods and the investment goods sectors with the following steps:

(i) Based on the integrated 24-sector I–O tables, calculate the 24×24 input-coefficient matrix denoted by matrix $\mathbf{A}$.
(ii) Calculate the Leontief matrix $(\mathbf{I} - \mathbf{A})$. Omit Sectors (23) and (24) from the results and calculate its inverse matrix $(\mathbf{I} - \mathbf{A})^{-1}$, which is a 22×22 matrix.
(iii) Multiply the private consumption ($\mathbf{C}$) and the private investment ($\mathbf{F}$) column vectors constructed by eliminating Sectors (23) and (24) of the 24-sector I–O table by $(\mathbf{I} - \mathbf{A})^{-1}$ and calculate the induced vectors $(\mathbf{I} - \mathbf{A})^{-1}\mathbf{C}$ and $(\mathbf{I} - \mathbf{A})^{-1}\mathbf{F}$.
(iv) With the output deflators of the National Accounts Database, reevaluate those values at 1985 constant prices.
(v) Multiply the capital and coefficient vectors, which are calculated based on the Japanese National Accounts Database.
(vi) As the total sum of the element of vectors calculated in Step (v), $\mathbf{K}_{\mathrm{C}}$, $\mathbf{K}_{\mathrm{I}}$, $\mathbf{L}_{\mathrm{C}}$, and $\mathbf{L}_{\mathrm{I}}$ will be obtained.
(vii) From the results in Step (vi), each sector's capital intensity will be calculated.

The same procedures will be applied to other OECD countries: the United States, Canada, France, and West Germany. All the data sets are explained in the Data Appendix.

3. EMPIRICAL RESULTS

3.1. Postwar Japanese Economy

The detailed calculation results are not reported here, but all the tables and figures are constructed based on them.[9] It is convenient to divide the history of postwar Japan into the following four periods: high-speed growth era (1955–1975), stable growth era (1975–1985), bubble era (1985–1991), after bubble (1991–).

First of all, let us see how each sector's capital intensity changed in postwar Japan.

In Figure 1, the C-sector and I-sector mean the consumption goods and the investment goods sectors, respectively. We find the following facts from the graph:

Fact 1. Through the observation period (1955–1995), both sectors' capital intensities grew in an exponential manner. The consumption goods sector also increased capital intensity much faster than the investment goods sector.

Fact 2. During the high-speed growth era, the investment goods sector was more capital-intensive than the consumption goods sector. After the 1973 oil shock, through the stable growth and bubble eras, the consumption goods sector turned out to be more capital-intensive than the investment goods sector.

Note that Fact 1 implies that both sectors grew at sector-specific growth rates. We may call this phenomenon "unbalanced growth," which is not explained by the standard two-sector models. The last finding of Fact 2 is very important, because it implies that in postwar Japan, just after the 1973 oil shock, a capital-intensity reversal occurred. To confirm this fact, let us define the two-sector capital-intensity ratio as follows:

$$\text{the two-sector capital intensity ratio} = \frac{\text{capital intensity of the consumption sector}}{\text{capital intensity of the investment sector}}.$$

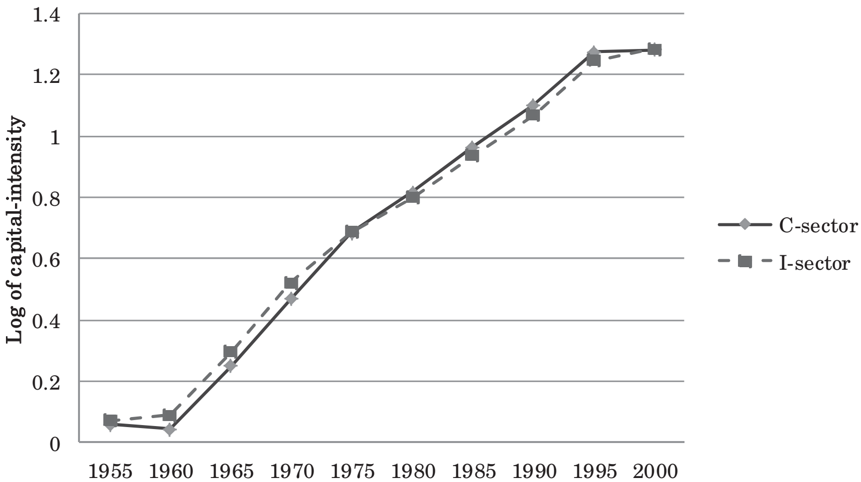

FIGURE 1. Two-sector capital intensities.

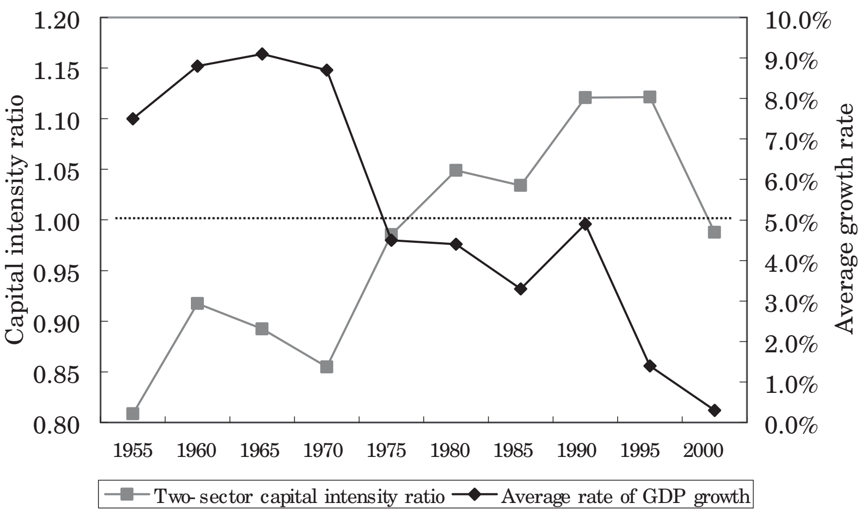

FIGURE 2. Capital-intensity ratios in the postwar Japanese economy.

Figure 2 shows the graphs of the two-sector capital-intensity ratio and the average annual growth rate of the real GDP.

Because the graph of the capital-intensity ratio crosses the horizontal line indicating 1.00 from below in Figure 2, the capital intensity was clearly reversed just around 1975. However, note that, from Fact 1, the capital intensity of the consumption goods sector grew faster than that of the investment goods sector. Thus sooner or later, the capital intensity of the investment goods sector could

TABLE 1. Annual average percentage change of inputs and intensities

	Ranges of years								
	55–60	60–65	65–70	70–75	75–80	80–85	85–90	90–95	95–00
				C-sector					
Capital input	4.70	13.67	14.12	11.09	7.40	7.48	5.39	11.28	0.66
Labor input	−1.15	3.29	3.25	1.02	0.87	1.13	−1.72	5.16	−1.00
Capital intensity	5.91	10.04	10.52	9.97	6.47	6.28	7.24	5.82	1.68
Type	D	W	W	W	W	W	D	W	D
				I-sector					
Capital input	26.42	8.78	19.82	5.18	4.31	6.89	12.01	6.14	4.38
Labor input	22.41	−1.69	7.48	−1.60	−0.80	0.29	6.14	0.31	0.09
Capital intensity	3.27	10.65	11.48	6.89	5.15	6.58	5.53	5.81	4.29
Type	W	D	W	D	D	D	w	D	D

Note: D, capital-deepening process; W, capital-widening process.

be overwhelmed by that of the consumption goods sector without the occurrence of the 1973 oil shock. To see what actually happened, we need to observe each sector's labor and capital inputs in detail. To observe this in more detail, we also list the average annual change in each input in Table 1.

Based on Table 1, from 1970 to 1975, the consumption goods sector accumulated capital stock at an average annual rate of more than 12% but increased labor input by less than 1.3%. On the other hand, the investment goods sector accumulated its stock at an average annual rate of 6% but reduced labor input by 2%. Based on this fact, we may conclude as follows:

Fact 3. The consumption goods sector greatly increased its capital intensity compared with the investment goods sector. Because of this, the 1973 oil shock did not cause the capital-intensity reversal, but just accelerated it.

Finally, from Table 1, we may also read the following fact:

Fact 4. The consumption goods sector mainly increases its capital intensity through capital-widening processes. On the other hand, the investment good sector mainly did so through capital-deepening processes.

3.2. Demand and Technology Effects

The capital intensities will be affected by changes in the demand structure as well as by technology changes. For example, if the demand for television sets and electric refrigerators increases, then it will surely affect the capital intensity of the consumption goods sector. Indeed, in the latter half of the 1960s, we observed explosive development of the consumer durables industries, producing automobiles, color television sets, and air conditioners. So we need to distinguish the two effects. We will use the following method to do so: Consider two consecutive periods (10 years), say 1960, 1965, and 1970. Let us denote the 1965 technology by the 1965 input–output matrix $\mathbf{A}_{65}$ and the final demand vectors of those years as $\mathbf{C}_{60}, \mathbf{C}_{65}, \mathbf{C}_{70}, \mathbf{I}_{60}, \mathbf{I}_{65}$, and $\mathbf{I}_{70}$. We can compute the capital intensities κ_C^{65-60}, κ_I^{65-60}, κ_C^{65-70}, and κ_I^{65-70}, where the superscript "65–60" means that the intensity is calculated using the 1960 final demand vectors based on the 1965 input–output matrix, and so forth. The difference of calculated intensities will measure demand effects. Similarly we may calculate the capital intensities κ_C^{60-65}, κ_I^{60-65}, κ_C^{70-65}, and κ_I^{70-65}, where the superscript "60–65" means that the intensity is calculated using the 1960 input–output matrix based on the 1965 final demand vectors, and so forth. The difference of the calculated intensities will measure the technology effects. Note that we may regard these technology effects as a change in the sector's total factor productivity (TFP), as discussed by Miller and Blair (2009). We compute these intensities for any two consecutive periods from 1955 to 2000. Table 2 reports the results.

The demand effects can be identified by reading the table in the vertical direction. The horizontal direction shows the technology effects. For both sectors, the technology effects are clearly identified, but the demand effects are hardly observed in either sector. In contrast, demand effects as well as technology effects took important roles in the capital-intensity reversal observed around 1975. This is clearly observed in the last part of Table 2. The intensity ratio rose along the vertical direction from 1955 to 1970. But this phenomenon cannot be observed after 1975. Thus the driving force of the capital-intensity reversal is not only the technology effect accruing from the changes of TFP, but also changes in the demand structure.

3.3. Comparison with Other Countries

Let us compare the results concerning the postwar Japanese economy with those for other OECD countries. We use the OECD Input–Output Tables (1995) and the OECD Industrial Structure Statistics (1995) as the data set. Of course, we cannot cover all years. The results for the United States, Canada, France, and West Germany are summarized in Figure 3.

We have the following important observation.

Fact 5. The capital-intensity reversal cannot be observed, and the consumption goods sector is more capital-intensive than the investment goods sector over the observation period in those countries.

Finally, we have to be careful with our results, because all our results crucially depend on the national accounts database used here. Especially, the private capital stock data are critical for our estimates.[10] Because of this, we need to compare our empirical results with those derived from a database different from ours to confirm the robustness of the results. Fortunately, we have the Keio Database (KDB), which is constructed based on I–O tables completely different from those used here. Our method was applied to the KDB, and almost identical results were obtained.[11] So we may conclude that our results are robust.

TABLE 2. Demand and technology effects

	Technology effect								
Demand effect	1955	1960	1965	1970	1975	1980	1985	1990	1995
				C-sector					
1955	0.8	1.1							
1960	0.9	1.1	1.7						
1965	0.9	1.1	1.8	2.9					
1970			2.0	3.0	5.1				
1975				2.8	4.8	6.7			
1980					4.6	6.5	8.3		
1985						4.8	8.9	11.9	
1990							9.3	12.6	16.3
1995								12.6	16.7
2000									14.9
				I-sector					
1955	1.0	1.3							
1960	1.0	1.2	2.0						
1965	1.0	1.2	2.0	3.4					
1970			2.1	3.5	5.2				
1975				3.2	4.8	7.0			
1980					4.7	6.2	8.3		
1985						6.4	8.6	10.8	
1990							8.9	11.2	14.4
1995								11.5	14.9
2000									14.0
				C/I intensity ratio					
1955	0.81	0.85							
1960	0.89	0.92	0.88						
1965	0.92	0.95	0.89	0.85					
1970			0.92	0.85	0.99				
1975				0.89	0.99	0.96			
1980					0.98	1.05	1.00		
1985						0.74	1.03	1.09	
1990							1.05	1.12	1.13
1995								1.09	1.12
2000									1.07

4. THEORETICAL IMPLICATIONS

Based on our empirical study, we have documented five facts that characterize the postwar Japanese economy and other major OECD countries. We need to inquire whether or not the standard two-sector growth theories can account for these findings. Among others, they should answer the following two important questions:

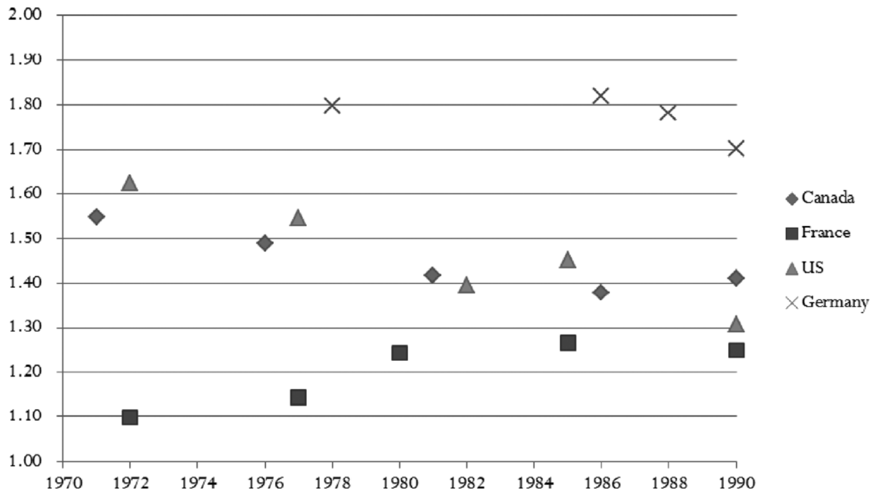

FIGURE 3. Capital-intensity ratios in OECD countries.

(i) Why is the capital-intensity reversal observed only in the Japanese economy?
(ii) Why did the Japanese per capita capital of both sectors grow exponentially at a sector-specific rate even after the capital-intensity reversal took place.

The core theory to answer question (i) is the basic theorems demonstrated by Benhabib and Nishimura (1985). In the two-sector optimal growth model framework, they have demonstrated the followins: When the investment goods sector is more capital-intensive, he equilibrium capital stock will then expand (Theorem 2'). On the other hand, when the consumption goods sector is more capital-intensive, the equilibrium capital stock will then converge to a stationary point or a cycle of period two (Theorem 3). Therefore, under an elastic labor supply, if the investment goods sector is more capital–intensive than the consumption goods sector and expands, the investment goods sector's expansion will be magnified because of the Rybczynski Theorem: An increase in the endowment of a factor will increase by a greater proportion the output of the sector that uses the factor intensively. In fact, we witnessed that "investment called forth more investment"[12] in the high-speed growth era. Let us refer to this phenomenon as the "magnification effect." Actually, during the early period from 1955 to 1965 in the first stage of the high-speed growth era, the labor supply was very elastic and many young people migrated from rural areas to urban areas as the labor force. Indeed, the active job-opening rate exceeded one in 1967 for the first time, and this situation lasted until 1973. From Figures 3 and 4, the capital-widening process occurred in the Japanese high-growth era. In the latter stage of the high-speed growth era, we may easily speculate that the wage-rental rate soared, and both sectors substituted their inputs from labor to capital. Further, this accelerated the increase in capital intensity in both sectors. Again, Figures 3 and 4 show that the capital-deepening process occurred from 1970 to 1985, especially in the investment goods sector. The consumption goods sector lowered its labor input growth from 3% to 1%

annually. The consumption goods sector's capital intensity then overwhelmed that of the investment goods sector around 1975. As argued before, the changes in demand structure also accelerated this process.

This entire story reminds us of the famous phase diagram drawn in Uzawa's 1965 two-sector optimal growth model paper, where the initial stocks are given in an unstable region where the investment goods sector is more capital-intensive than the consumption goods sector. The optimal path then grows further and moves into the stable region where the consumption goods sector is more capital-intensive because of the soaring wage-rental ratio. At the end, the optimal path will converge to an optimal steady state, where the capital intensities of both sectors are constant.

The last statement is closely related to question (ii). If we follow Uzawa, it clearly suggests that the postwar Japanese economy followed the transition path and converged to a steady state where the growth rate of each sector's per capita stock would turn out to be zero. In contrast, our calculations suggest that even after the transition periods, the capital intensities in Japan still grew exponentially until 1995. In fact, from 1980 to 1995, the capital intensity of each sector grew at a sector-specific constant rate, which is closely related to the sector's TFP growth. Based on Table 1, we will find that the average growth rates of the consumption goods and the investment goods sectors are 6.5% and 6%, respectively. In other words, each sector's steady state has a sector-specific positive growth rate. Following Baumol (1967), we may call this phenomenon "unbalanced growth." However, the standard two-sector optimal growth models cannot explain this phenomenon, as we mentioned before. Takahashi (2009) has set up a multisector optimal growth model (one consumption goods sector and n capital goods sectors) with an exogenous sector-specific TFP growth rate and has demonstrated that an optimal path of each sector's per capita capital (capital intensity) will converge to its own optimal steady state with a sector-specific TFP growth rate, if the generalized capital-intensity condition holds, which equivalently means in two-sector models that the consumption goods sector is more capital-intensive than the capital goods sector.

Finally, based on Fact 5, the consumption goods sector is far more capital-intensive than the investment goods sector in other OECD countries. This implies that there is no magnification effect in those countries and thus we cannot observe capital-intensity reversal over the observation periods.

5. CONCLUDING REMARKS

The remaining interesting problem is to measure the two-sector capital-intensity ratios for other East Asian countries, say Taiwan, Korea, and China. We applied the same method to the postwar Korean economy and found empirical evidence that, by 1995, the two-sector capital-intensity ratio had reached 0.96.[13] This may imply that, sooner or later, we could observe the appearance of capital-intensity reversal in Korea, too. Unfortunately, we do not have enough data to estimate after 1995. Because the capital stock data of Taiwan and China were not obtained at this time, we gave up on estimating the capital intensities of both countries.

Finally, we would like to emphasize again that the capital intensity does matter and the empirical evidence examined previously will strongly support the most commonly used capital-intensity assumption in the two-sector growth literature: the consumption goods sector is more capital-intensive than the capital goods sector.

NOTES

1. In the interview, Uzawa told his interesting story about how he had reached an idea of two-sector growth models.
2. These authors have written more papers concerned with this subject than are listed here. Moreover, in a multisector optimal growth model, the relation between factor intensity and the Hopf bifurcation has been studied by Nishimura and Takahashi (1992).
3. See p. 4 in Solow (2005).
4. Some exceptions are Dollar and Wolff (1994) and Gilchrist and Williams (2001).
5. For a detailed recent argument concerned with the paradox, see Wolff (2004).
6. The 1960 I–O Table did not separate public investment from private investment. So we estimated the 1960 capital intensity for aggregated capital stock. Moreover, these tables are the so called "competitive-import" type and the intermediate deliveries include both domestically produced and imported goods.
7. (1) Agriculture and forestry and fishery, (2) mining, (3) food and beverages, (4) textiles, (5) pulp, paper, and wooden products, (6) chemicals, (7) petroleum and coal products, (8) nonmetallic mineral products,(9) basic metals, (10) fabricated metal products, (11) machinery, (12) electrical machinery, equipment, and supplies, (13) transport equipment, (14) precision instruments, (15) other manufactures, (16) construction, (17) electricity, gas, and water supplies, (18) wholesale and retail trade, (19) finance and insurance, (20) real estate, (21) transportation and communication, (22) services, (23) unclassified, (24) government services.
8. Also note that because the construction sector, which is extremely labor-intensive, is classified in the investment good sector, the overestimation of the consumption goods sector will provide a serious bias for estimating capital intensities.
9. The detailed calculation results will be provided upon request.
10. Some researchers have pointed out that the capital stock data estimated by the Economic and Social Research Institute are overestimated because of the estimation method. Thus, to confirm our results, we need to apply our method to the other database.
11. Kohji Nomura at Keio University kindly reestimated the capital intensities with the KDB from 1960 to 1998.
12. See Chapter 7 of Kosai (1986).
13. Yoshihisa Godo at Meiji Gakuin University kindly provided us with the Korean fixed capital data estimated by H. K. Pyo at Seoul National University.

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DATA APPENDIX

A.1. DATA FOR THE JAPANESE ECONOMY

- *The Input–Output Tables:* The 46-sector 1955–1990 I–O table published by the Research Institute of Economy, Trade and Industry in CD-ROM format. The 1995 and 2000 I–O Tables were downloaded from the following site: http://www.stat.go.jp/english/data/io/index.htm.

- *Private Capital Stock Data:* The gross capital stock of private enterprises (installation base) data in the *Annual Report on National Accounts,* published by the Economic and Social Research Institute.
- *Labor Input Data:* The data on employed persons by the kind of economic activity in the *Annual Report on National Accounts,* published by the Economic and Social Research Institute.
- *1985 Deflator:* The output deflator by the kind of economic activity in the *Annual Report on National Accounts,* published by the Economic and Social Research Institute.

A.2. DATA FOR THE OECD COUNTRIES

- *The Input–Output Tables: The OECD Input–Output Database*, published by the OECD in 1995.
- *Private Capital Stock, Labor Input, and 1985 Deflator Dataset:* The Industrial Structure Statistics published by the OECD in 1998.